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supplied with current is in the holding phase. This is because, at this point in time, it is ensured that the coil of the circuit for which the offset error is being determined is not supplied with current. In the capture phase, this is not ensured, since for example the current from its previous holding phase can still decay or, under certain circumstances, the coil is still briefly supplied with current during the capture phase for the delayed transfer of the actuator into the other final position.

Advantageous refinements of the invention are characterized in the subclaims.

An exemplary embodiment of the invention is explained in more detail below with reference to the drawings, in which:

figure 1 shows a section through an actuator for a gas exchange valve of an internal combustion engine,

figure 2 shows the time series of the current flow through the two coils of figure 1,

figure 3 shows a circuit for sensing the coil current through a coil and

figure 4 shows the states passed through during the operation of the gas exchange valve in a flow diagram.

A8> Figure 1 shows an electromagnetic actuator 1 for a gas exchange valve which is designed as a disk valve and comprises a valve disk 2 with a valve seat 3 and a valve stem 4, which is mounted in a guide 5 on the housing side and is provided at the upper end with a conical piece 6. The valve disk is moved by the

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actuator 1 between two final positions: in an upper final position, the gas exchange valve is closed and in a lower final position it is open.

- 5 A valve spring 8 arranged between the guide 5 on the housing side and the conical piece 6 acts on the valve disk, urging it into the closed position.

The actuator 1 further comprises an upper ferromagnetic coil former 10 and a lower ferromagnetic coil former 12, which respectively carry a coil 14 and 16.

Displaceably mounted within the upper coil former 10 is an armature shaft 17, which has a plate-shaped armature 18, which lies between the two coils 14, 16. The end faces 19 and 20 of the two coil formers 10 and 12, facing the armature 18, form stops for the armature 18 and consequently define the upper and lower final positions of the gas exchange valve, in which it is open or closed.

An actuator spring 22 is clamped between the armature shaft 17 and a stop 24 on the housing side and acts on the armature 18 in the direction of the open position of the valve disk 2. The armature 18 rests on the valve stem 4. As long as the coils 14 and 16 are not supplied with current, the armature 18 is held by the valve spring 8 and the actuator spring 22 in the midway position between the two end faces 19 and 20, as represented in the drawing.

The two coils 14 and 16 are respectively supplied with current by a driver circuit 26, 27, which are activated by a control circuit 28.

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For measuring the travel of the armature disk 2, a piezo element 30' is also provided on the actuator spring support. A further piezo element 32' is

provided on the guide 5 on the housing side. The output signals of the two piezo elements 30', 32' are fed to the control circuit 28, which uses them for the purpose of controlling the striking speed of the armature 6 against the coil formers 10 and 12 on the end faces 19 and 20, respectively, in such a way that the valve can be transferred into the respective final position without bouncing, with little noise, quickly and reliably.

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A 9 > In figure 2, the current I through the coil 14 or 16 is plotted over time t . In this case, the current I through the coil 14 is represented by a solid line, the current through the coil 16 is represented by a dashed line. This current flow is set by the control circuit 28, in order with the aid of a capture current circuit to switch the valve over into the other final position, respectively, reliably and without bouncing. For this purpose, the holding current H_s , H_o holding the armature 18 in the respective final position is switched off, so that the armature is set in motion in the direction of the other final position by the relevant, relaxing spring. At the same time, the corresponding winding 14 or 18 is supplied with the capture current F_o , F_s . For closing the valve, the coil 14 is supplied with the capture current F_s . If the armature 18 is resting on the end face 19, the coil 14 is then only supplied with lower holding current H_s , which is sufficient to hold the armature 18, and consequently the gas exchange valve, in the closed position.

For opening the gas exchange valve, the holding current H_s through the coil 14 is switched off and the capture current F_o through the coil is switched on. Once the armature 18 has come up against the end face 20 under the action of the valve spring 8 and the actuator spring 22 and also the magnetic field generated by the

capture current F_o , the supply of current to the coil 16 is switched over to the holding current H_o and the valve disk 2 is held in the open position. To close the valve again, the holding current H_o is analogously
5 switched off and the capture current F_s is switched on.

A10 In other words, the gas exchange valve passes through the states I to IV represented in figure 4. In state I, the valve is closed and the holding current H_s is
10 flowing in the coil 14. Next, in state II, the valve is opened, for which purpose the coil 16 is supplied with the capture current F_o , and the holding current H_s in the coil 14 slowly decays. Once the armature 18 has come up against the end face 20, the supply of current
15 to the coil 16 is switched over to the holding current H_o and the valve is open (state III of figure 4). For closing, the coil 14 is in turn provided with capture current, which is represented in figure 4 as state IV. Once the armature 18 has come up against the end face
20 19, state I exists again.

In order then to be able to use the current through the coil 14, 16 in the control circuit 28, a measurement of the coil current is necessary. The driver circuit
25 required for this purpose is represented together with a more accurate representation of the control circuit 28 by way of example in figure 3. Figure 3 shows the driver circuit 26 for the coil 14. The driver circuit 27 is designed in an analogous way.

30 As can be seen in figure 3, the coil 14 is activated by an asymmetric half-bridge. In this case, the coil 14 is connected between a highside FET T_h , which on the other hand is connected to the supply voltage V_{cc} , and
35 a lowside FET T_l , which in turn is connected on the other hand via a resistor R to the reference potential. Connected in the forward direction between the reference potential and the connecting nodes of the

For determining the offset error, it must be ensured
 that the resistor R is not flowed through by a current.
 This can only be ensured for the coil 14 in the holding
 phase of the other coil 16, since this concerns a final
 position in which the coil 14 for the circuit 26 of
 which the offset error is to be determined is not
 supplied with current. After determination of the
 offset error I_o of the non-activated coil, the actual
 current I_m can be corrected as follows when the coil is
 next activated in the then-following cycle:

$$I_{corr} = I_m - I_o$$

Preferably, the offset error I_o is measured by being
 sampled several times in the coil 14 and a weighted
 average value is formed as follows by using the
 measured values:

$$I_{o,i} = I_{o,i+1} \cdot (1-k) + I_m \cdot k$$

This weighted average value is one possible form of
 low-pass filter; others are conceivable. In this case,
 $I_{o,i}$ is the i th measurement of the offset error, I_m is
 the actual value of the current (raw value of the
 analog/digital converter 34) and k is a weighting
 factor.

This low-pass filtering takes account of the
 realization that the offset error I_o fluctuates in a
 temperature-dependent manner and changes only slowly
 with respect to the sampling rate with which the offset
 error is determined.

The invention was described above in the case of
 application to an actuator 1 for a gas exchange valve
 of an internal combustion engine. However, it is not
 restricted to this, but may also be applied to other
 actuators. The actuator also does not have to have two
 coils; it is sufficient for there to be one final
 position in which a coil is not supplied with current.